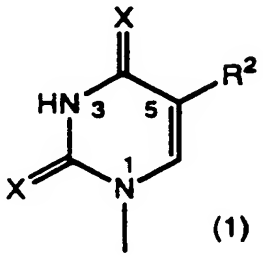
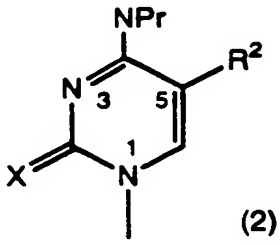
CLAIMS

1. An oligomer comprising at least two nucleomonomers and pharmaceutically acceptable salts thereof wherein at least one of said nucleomonomers comprises a base of formula (1) or (2):



(1)



(2)

wherein each X is independently O or S;

R^2 is a group comprising at least one pi bond connected to the carbon atom attached to the base; and

Pr is $(H)_2$ or a protecting group,

with the proviso that when at least one of said nucleomonomers of said oligomer comprises deoxyuridine 5-substituted by vinyl, 1-butenyl, 1-pentenyl, 1-hexenyl, 1-heptenyl, 1-octenyl, 1-propynyl, 1-butynyl, 1-hexynyl, 1-heptynyl, or 1-octynyl, then the remainder of the nucleomonomers comprising said oligomer are not solely comprised of phosphodiester linked 2'-deoxyadenosine, 2'-deoxyguanosine, 2'-deoxycytidine, thymidine or a combination thereof.

2. The oligomer of claim 1 wherein X is O.

3. The oligomer of claim 1 or 2 wherein R^2 is not phenyl.

4. The oligomer of claim 1 or 2 wherein R^2 is cyano, C_{2-12} 1-alkenyl or 1-alkynyl or is a C_{2-12} heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in which one to three of the ring atoms is N, S or O.

5. The oligomer of claim 4 wherein R^2 is C_{2-8} 1-alkenyl or 1-alkynyl or is a C_{2-8} heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in which one ring atom is replaced by N and optionally in which a second ring atom is N, S or O.

6. The oligomer of claim 5 wherein R^2 is selected from the group consisting of phenylethynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-, 4-, and 5-oxazolyl, 2- and 3-furanyl, 2- and 3-pyrrolyl, propenyl, vinyl and -C≡C-Z where Z is H, alkyl (C_{1-10}), haloalkyl (C_{1-10} with 1 to 6 halogen atoms) or heteroalkyl (C_{1-10} with 1 to 3 heteroatoms).

7. The oligomer of claim 1 wherein R^2 is selected from the group consisting of 1-propynyl, 1-propenyl, 3-buten-1-ynyl, 3-methyl-1-butynyl, 3,3-dimethyl-1-butynyl, 1,3-pentadiynyl, 1-butynyl, ethynyl, vinyl, bromovinyl, phenylethynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl,

triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-, 4-, and 5-oxazolyl, 2- and 3-furanyl, and 2- and 3-pyrrolyl.

8. The oligomer of claim 1 wherein R^2 is 1-propynyl.

9. The oligomer of claim 8 wherein at least one substitute linkage is a phosphorothioate linkage.

10. The oligomer of claim 9 wherein all substitute linkages are phosphorothioate linkages.

11. The oligomer of claim 1 wherein at least one substitute linkage is a phosphorothioate linkage.

12. The oligomer of claim 11 wherein all substitute linkages are phosphorothioate linkages.

13. The oligomer of claim 1 wherein at least one linkage is a substitute linkage.

14. The oligomer of claim 13 wherein the substitute linkage is selected from the group consisting of phosphoramidate, phosphorothioate, methylphosphonate, riboacetal, amide, N-methylhydroxylamine,

thi n methylphosphonate, phosphorodithioate, 2',5' linkages, formacetal, and 3'-thioformacetal.

15. The oligomer of claim 14 wherein said substitute linkage is methylphosphonate or phosphorothioate.

16. The oligomer of claim 3 wherein at least one substitute linkage is a phosphorothioate linkage.

17. The oligomer of claim 16 wherein all substitute linkages are phosphorothioate linkages.

18. The oligomer of claim 3 wherein at least one linkage is a substituted linkage.

19. The oligomer of claim 18 wherein the substitute linkage is selected from the group consisting of phosphoramidate, phosphorothioate, methylphosphonate, riboacetal, amide, N-methylhydroxylamine, thionomethylphosphonate, phosphorodithioate, 2',5' linkages, formacetal, and 3'-thioformacetal.

20. The oligomer of claim 19 wherein said substitute linkage is methylphosphonate or phosphorothioate.

21. The oligomer of claim 1 that further comprises at least one segment of inverted polarity.

22. The oligomer of claim 21 that further comprises at least one o-xyloso switchback linker.

23. The oligomer of claim 22 wh rein the o-xyloso switchback linker comprises at least one base of formula (1) or (2) as defined in claim 1.

24. The oligomer of claim 1 wherein at least one base comprises a covalent bonding moiety.

25. The oligomer of claim 24 wherein said base is N^4,N^4-ethanocytosine.

26. The oligomer of claim 1 complexed with a cationic lipid.

27. The oligomer of claim 1 further comprising from about 10 to about 30 nucleomonomers and having uniform polarity.

28. The oligomer of claim 27 further comprising about 2 to about 12 substituted linkages or nucleomonomers at the 5′- end and at the 3′- end which comprise nuclease stable domains, and about 3 to about 26 substituted linkages or nucleomonomers which comprise at least one RNase H competent domain and is between the nuclease stable domains.

29. The oligomer of claim 3 complexed with a cationic lipid.

30. The oligomer of claim 3 further comprising from about 10 to about 30 nucleomonomers and having uniform polarity.

31. The oligomer of claim 4 wherein said nucleomonomer is a 2′- modified nucleomonomer.

32. The oligomer of claim 31 wherein at least one of the nucleomonomer is a 2′-O-allyl modified nucleomonomer.

33. The oligomer of claim 1 having a covalent link between the 5′ nucleomonomer and the 3′ nucleomonomer whereby a circular oligomer is formed.

34. The oligomer of claim 1 conjugated to a solid support, label, or amine linker (1-12C).

35. The oligomer of claim 1 which is a dimer, trimer, tetramer, pentamer or hexamer.

36. The oligomer of claim 3 conjugated to a solid support, label, or amine linker (1-12C).

37. The oligomer of claim 3 which is a dimer, trimer, tetramer, pentamer or hexamer.

38. An oligomer of claim 1 comprising a positive modification comprising at least one base of formula (1) or (2) and a negative modification, with respect to the binding affinity of the oligomer to a complementary nucleic acid sequence, wherein the positive modification counteracts the effect of the negative modification to a degree that is more than additive with respect to the binding affinity.

39. The oligomer of claim 38 wherein the positive modificati n R^2 is cyano, C_{2-12} 1-alkenyl or 1-alkynyl or is a C_{2-12} heteroaromatic or 1-ethynyl-heteroaromatic group containing 5-6 ring atoms in which one to three of the ring atoms is independently N, S or O.

40. The oligomer of claim 39 wherein the heterocycle base modification R^2 is C_{2-8} 1-alkenyl or 1-alkynyl or is a C_{2-8} heteroaromatic or 1-ethnynl-heteroaromatic group containing 5 to 6 ring atoms in which one ring atom is N and optionally in which a second ring atom is N, S or O and each X is O.

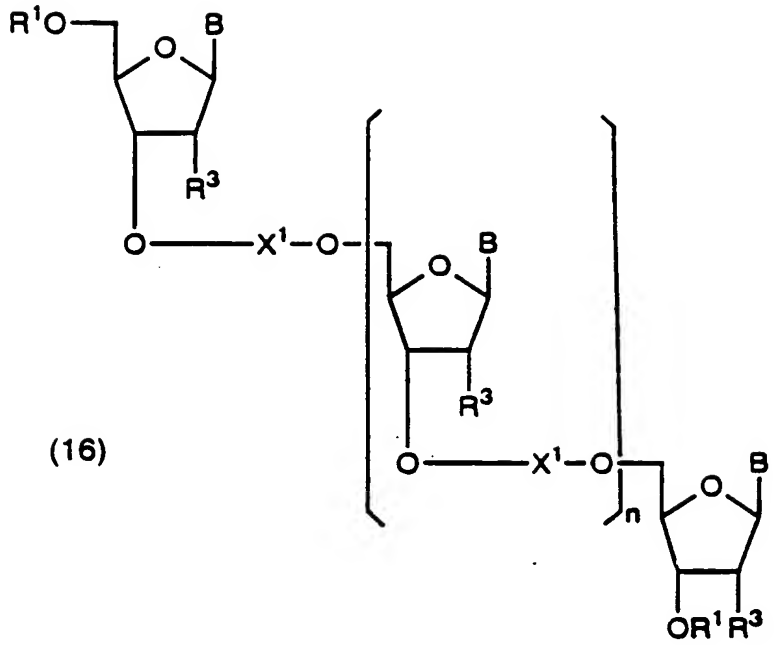
41. The oligomer of claim 37 wherein the negative modification is a substitute linkage.

42. The oligomer of claim 41 wherein the substitute linkage comprises at least one linkage selected from the group consisting of phosphorothioate, thionomethylphosphonate, methylphosphonate, phosporoamidate and triester for a phosphodiester linkage.

43. The oligomer of claim 1 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

44. The oligomer of claim 3 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

45. An oligomer of the formula (16):



(16)

wherein each R^1 is independently H, PO_3^{-2}, or a blocking group;

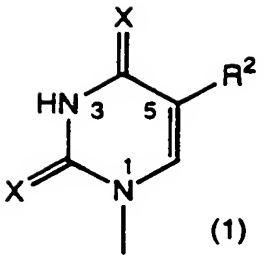
each R^3 is independently selected from the group consisting of H, OH, F, NH_2, OCH_3, OC_2H_5, OC_3H_7, SCH_3, SC_2H_5, SC_3H_7, OC_3H_5, and SC_3H_5;

each X^1 is independently a substitute linkage selected from the group consisting of -P(S)(O)-, -P(O)(O)-, -P(Me)(O)- and -P(Me)(S)-.

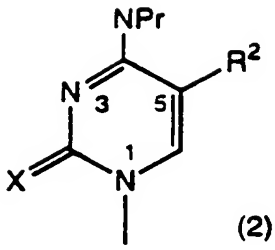
Pr is a protecting group;

n is an integer from 0 to 98; and

B is a purine or pyrimidine base, provided that at least one B is of formula (1) or (2):



(1)



(2)

wherein each X is independently O or S; R^2 is a group comprising at least one pi bond connected through a carbon attached to the base; and

Pr is H_2 or a protecting group and

with the proviso that when at least one of said nucleomonomers of said oligomer comprises deoxyuridine 5-substituted by vinyl, 1-butenyl, 1-pentenyl, 1-hexenyl, 1-heptenyl, 1-octenyl, 1-propynyl, 1-butynyl, 1-hexynyl, 1-heptynyl, or 1-octynyl, then the remainder of the nucleomonomers comprising said oligomer are not solely comprised of phosphodiester linked 2'-deoxyadenosine, 2'-deoxyguanosine, 2'-deoxycytidine, thymidine or a combination thereof.

46. The oligomer of claim 45 wherein at least one B is 5-propynyluracil, 5-(3-methyl-1-butynyl)uracil, 5-propynylcytosine or 5-(3-methyl-1-butynyl)cytosine.

47. The oligomer of claim 45 wherein at least one B is 2-thienyluracil, 2-thienylcytosine, 2-imidazoyluracil, 2-imidazoylcytosine, 2-thiazoyluracil or 2-thiazoylcytosine.

48. The oligomer of claim 45 wherein at least one R^1 is H, PO_3^{-2}, DMT, MMT, H-phosphonate, methyl phosphonamidite, methylphosphoramidite, β-cyanoethylphosphoramidite or alkylphosphoramidite.

49. The oligomer of claim 45 wherein each R^3 is independently H, OH, or -O-allyl.

50. The oligomer of claim 50 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

51. The oligomer of claim 45 wherein R^2 is 1-propynyl.

52. The oligomer of claim 51 further comprising from about 10 to about 30 nucleomonomers and having uniform polarity and further comprising about 2 to about 12 substituted linkages or nucleomonomers at the 5′- end and at the 3′- end which comprise nuclease stable domains, and about 3 to about 26 substituted linkages or nucleomonomers which comprise at least one RNase H competent domain and is between the nuclease stable domains.

53. The oligomer of claim 45 complexed with a cationic lipid.

54. The oligomer of claim 46 wherein the cationic lipid is DOTMA.

55. The oligomer of claim 45 wherein R^2 is not phenyl.

56. Th oligomer of claim 55 wherein at least one R^1 is H, PO_3^{-2}, DMT, MMT, H-phosphonate, methyl phosphonamidite, methylphosphoramidite, β-cyanoethylphosphoramidite or alkylphosphoramidite.

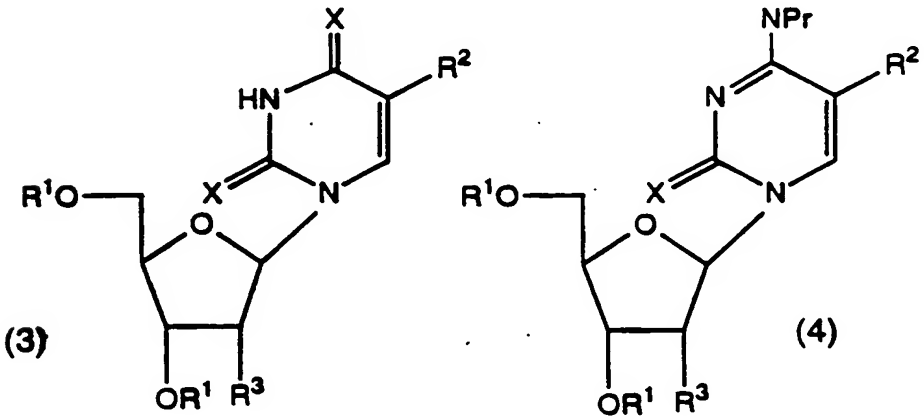
57. The oligomer of claim 55 wherein each R^3 is independently H, OH, or -O-allyl.

58. The oligomer of claim 55 wherein at least one R^3 is O-methyl, O-ethyl or O-propyl.

59. The oligomer of claim 55 complexed with a cationic lipid.

60. The oligomer of claim 59 wherein the cationic lipid is DOTMA.

61. A nucleomonomer having the structural formula (3) or (4):



wherein each R^1 is independently H or a blocking group;

R^2 is a group comprising at least one pi bond connected through a carbon atom attached to the base;

Pr is (H_2) or a protecting group; and

R^3 is selected from the group consisting of H, OH, F, OCH_3, OC_2H_5, OC_3H_7, SCH_3, SC_2H_5, SC_3H_7, OC_3H_5, and SC_3H_5,

with the proviso that if R^3 is H or OH, and both R^1 are H, R^2 is 1,3-pentadiynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-pyrimidine-ethynyl, 4-pyrimidine-ethynyl, 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 2- and 4-imidazolyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-thienyl-ethynyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-, 4-, and 5-thiazolyl-ethynyl, 2-, 4- and 5-oxazolyl-ethynyl, 4- and 5-thiazolyl, 4- and 5-oxazolyl, or 3-pyrrolyl.

62. The nucleomonomer of claim 61 wherein Pr is $(H)_2$.

63. The nucleomonomer of claim 61 wherein R^2 is 1-propynyl, 1-propenyl, 3-buten-1-ynyl, 3-methyl-1-butynyl, 3,3-dimethyl-1-butynyl, 1,3-pentadiynyl, 1-butynyl, ethynyl, vinyl, bromovinyl, phenylethynyl, 2-, 3-, and 4-pyridine-ethynyl, 2-, 4- and 5-pyrimidine-ethynyl, triazine-ethynyl, 2-pyrimidinyl, 4-pyrimidinyl, 5-pyrimidinyl, 2-, 4- and 5-oxazolyl-ethynyl, 2-, 4- and 5-thiazolyl-ethynyl, 1-methyl-2-imidazolyl, 2- and 4-imidazolyl, 2-, 4- and 5-oxazolyl, 2-, 4- and 5-imidazolyl-ethynyl, 2-pyridinyl, 3-pyridinyl, 4-pyridinyl, 2- and 3-thienyl-ethynyl, 2- and 3-furanyl-ethynyl, 2- and 3-pyrrolyl-ethynyl, 2- and 3-thienyl, 2-,

4-, and 5-oxazolyl, 2- and 3-furanyl, or 2- and 3-pyrrolyl; and

the blocking group is DMT, MMT, FMOC, hydrogen phosphonate, methylphosphonamidite, methylphosphoramidite or β-cyanoethylphosphoramidite.

64. The nucleomonomer of claim 63 wherein R^3 is H, OH or O-allyl.

65. The nucleomonomer of claim 63 wherein R^2 is 1-propynyl.

66. The nucleomonomer of claim 63 wherein R^1 at the 3′ position is selected from the group consisting of hydrogen phosphonate, N,N-diisopropylamino-ß-cyanoethoxyphosphine, N,N-diisopropyl-aminomethoxy-phosphine, N,N-diethylamino-ß-cyanoethoxyphosphine, N,N-morpholino-ß-cyanoethoxyphosphine, N,N-morpholino-methoxyphosphine, N,N-diisopropylaminomethyl-phosphonamidite, N,N-diethylamino-methylphosphonamidite, bis-morpholino-phosphine, N,N-dimethylamino-ß-cyanoethyl-mercaptophosphine, 2-chlorophenyl phosphate, 4-chlorophenyl phosphate, 2,4-dichlorophenyl phosphate, 2,4-dibromophenyl phosphate, 2-chlorophenyl thiophosphate, 4-chlorophenyl thiophosphate, 2,4-dichlorophenyl thiophosphate, and 2,4-dibromophenyl phosphate.

67. The nucleomonomer of claim 61 wherein R^2 is 1-propynyl.

68. The nucleomonomer of claim 61 wherein X is O;

R^1 at the 5′ position is DMT, MMT or FMOC;

R^1 at th 3′ position is N,N-diisopropylamino-ß-cyanoethoxyphosphine, N,N-diisopropylaminomethoxy-phosphine or hydrogen phosphonate;

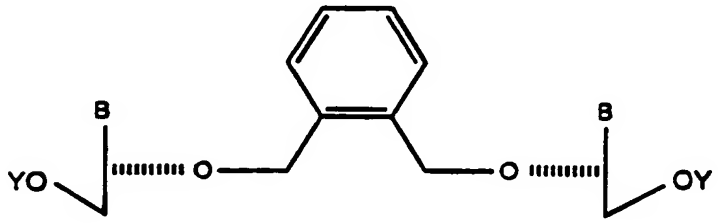
R^2 is 1-propynyl, 3-methyl-1-butynyl, 2-thienyl, 2-imidazolyl or 2-thiazolyl;

R^3 is H, OH, or O-allyl; and

Pr is $(H)_2$, diisobutylformamidine or another protecting group.

69. The nucleomonomer of claim 68 wherein Pr is benzoyl, diisopropylformamidine, FMOC, di-n-butylformamidine, or isobutyryl.

70. An o-xyloso dimer of the formula (5):



(5)

wherein

each Y is independently R^1 or an oligomer;

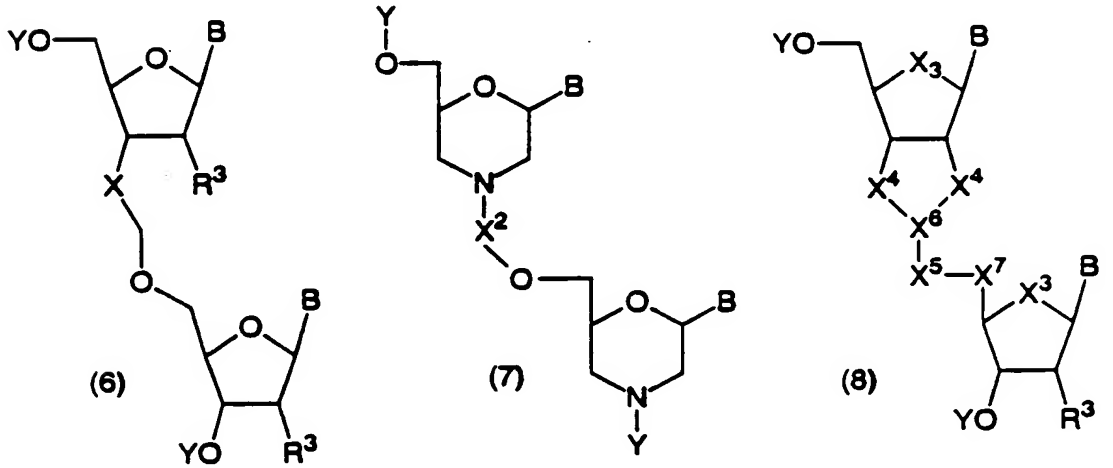
R^1 is H, PO_3^{-2} or a blocking group; and

each B is independently a purine or pyrimidine base, provided that at least one B is a base of formula (1) or (2), wherein R_2 is a group comprising at least one pi bond connected through a carbon atom attached to the base; and Pr is $(H)_2$ or a protecting group.

71. The dimer of claim 70 wherein R^2 is 1-propynyl.

72. The dimer of claim 70 wherein the blocking group is selected from the group consisting of DMT, MMT, hydrogen phosphonate, methylphosphonamidite, methylphosphoramidite, and β-cyanoethylphosphoramidite.

73. A dimer of the formula (6), (7) or (8):



wherein

X is selected from the group consisting of O and S;

X^2 is selected from the group consisting of CO, CS and SO_2;

X^3 is independently selected from the group consisting of O, S, CH_2, CF_2 and CFH;

X^4 is independently selected from the group consisting of O, S, SO, SO_2, CH_2, CO, CF_2, CS, NH and NR^4 wherein R^4 is lower alkyl (C_{1-4}; methyl, ethyl, propyl, isopropyl, butyl or isobutyl);

X^5 is selected from the group consisting of O, CO, S, CH_2, CS, SO_2, CO, NH and NR^4;

X^6 is selected from the group consisting of CH, N, CF, CCl, and CR^5 wherein R^5 is lower alkyl (C_{1-4}) fluoromethyl, difluoromethyl, trifluoromethyl or lower fluoroalkyl (C_{2-4}, F_{1-5});

X^7 is selected from the group consisting of O, S, CH_2, CO, CF_2 and CS;

each Y independently is an oligomer or R_1 wherein R_1 is PO_3^{-2} or a blocking group;

each R^3 is independently selected from the group consisting of H, OH, F, NH_2, OCH_3, OC_2H_5, OC_3H_7, SCH_3, SC_2H_5, SC_3H_7, OC_3H_5, and SC_3H_5;

each B is independently a purine or pyrimidine base, provided that at least one B is of formula (1) or (2) wherein each X is O or S;

R_2 is a group comprising at least one pi bond connected through a carbon atom attached to the base; and

Pr is $(H)_2$ or a protecting group;

and further provided that X^5 and X^7 are not both O.

74. The dimer of claim 73 wherein R^1 is PO_3^{-2}, DMT, MMT, H-phosphonate, methylphosphoramidite or β-cyanoethylphosphoramidite.

75. The dimer of claim 73 wherein at least one B is 5-propynyluracil, 3-methyl-1-butynyluracil, 5-propynylcytosine, or 3-methyl-1-butynylcytosine.

76. The dimer of claim 73 wher in at least one R^2 is propynyl, R^3 is H or OH and X in the substitute linkage is S.

77. The dimer of claim 73 of formula (8) wherein X^3 and X^4 are O, X^5 and X^7 are CH_2, and X^6 is CH.

78. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 1.

79. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 45.

80. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 1.

81. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 45.

82. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 3.

83. A duplex wherein one of the two oligomers of the duplex is comprised of an oligomer of claim 55.

84. A triplex wherein one of the three oligomers of the triplex is comprised of the oligomer of claim 3.

85. A triplex wherein one of the three olig mers of the triplex is comprised of the oligomer of claim 55.

86. The oligomer of claim 1 wherein the oligomer persists intact in cells or biological solutions for a period of time that is greater than a corresponding oligodeoxynucleotide.

87. The oligomer of claim 3 wherein the oligomer persists intact in cells or biological solutions for a period of time that is greater than a corresponding oligodeoxynucleotide.

88. The oligomer of claim 1 wherein the oligomer is a ribozyme.

89. The oligomer of claim 3 wherein the oligomer is a ribozyme.

90. The oligomer of claim 1 wherein the oligomer is a probe.

91. The oligomer of claim 3 wherein the oligomer is a probe.

92. The oligomer of claim 1 wherein the oligomer is a primer.

93. The oligomer of claim 3 wherein the oligomer is a primer.

94. A pharmaceutical composition, comprising:

a pharmaceutically acceptable carrier; and

a therapeutically effective amount of an oligomer of claim 1.

95. A method of treating a disease in a subject, which disease is characterized by a particular DNA duplex or RNA, comprising the steps of:

administering to a subject in need of such treatment a therapeutically effective amount of an oligomer of claim 1; and

allowing the oligomer to have sufficient time to bind to the DNA duplex or RNA.

96. A method of treating a disease in a subject, which disease is characterized by a particular DNA or RNA, the method comprising:

administering to a subject in need of such treatment a therapeutically effective amount of an oligomer of claim 1; and

allowing the oligomer to have sufficient time to bind to the DNA or RNA to form a triplex or duplex.

97. A method of detecting the presence, absence or amount of a particular double stranded or single stranded nucleic acid in a biological sample, comprising the steps of:

contacting the sample with an oligomer of claim 1 under conditions wherein a duplex or a triplex is formed between the oligomer and the nucleic acid; and

detecting the presence, absence or amount of said duplex or triplex.

98. A method of detecting the presenc , absence or amount of a particular single-stranded DNA or RNA in a biological sample, comprising the steps of:

contacting the sample with an oligomer of claim 1 under conditions wherein a hybrid duplex is formed between the oligomer and the DNA or RNA; and

detecting the presence, absence or amount of said duplex.

99. A method of inhibiting expression of at least one selected protein in a cell wherein the protein is encoded by DNA sequences and the protein is translated from RNA sequences, comprising the steps of:

introducing an oligomer of claim 1 into the cell; and

permitting the oligomer to form a triplex with the DNA or RNA or a duplex with the DNA or RNA whereby expression of the protein is inhibited.

100. The method of claim 99 wherein the oligomer is introduced into the cell by a method selected from the group consisting of calcium phosphate transfection, DMSO transfection, dextran transfection, electroporation, cationic lipid transfection, anionic lipid transfection or liposome transfection.

101. A method of introducing an oligomer of claim 1 into cells, comprising:

mixing the oligomer with a permeation enhancing agent to form a complex; and

contacting the complex with the cells.

102. A pharmaceutical composition, comprising:

a pharmaceutically acceptable carri r; and

a therapeutically effective amount of an oligomer of claim 3.

103. A method of treating a disease in a subject, which disease is characterized by a particular DNA duplex or RNA, comprising the steps of:

administering to a subject in need of such treatment a therapeutically effective amount of an oligomer of claim 3; and

allowing the oligomer to have sufficient time to bind to the DNA duplex or RNA.

104. A method of treating a disease in a subject, which disease is characterized by a particular DNA or RNA, the method comprising:

administering to a subject in need of such treatment a therapeutically effective amount of an oligomer of claim 3; and

allowing the oligomer to have sufficient time to bind to the DNA or RNA to form a triplex or duplex.

105. A method of detecting the presence, absence or amount of a particular double stranded or single stranded nucleic acid in a biological sample, comprising the steps of:

contacting the sample with an oligomer of claim 3 under conditions wherein a duplex or a triplex is formed between the oligomer and the nucleic acid; and

detecting the presence, absence or amount of said duplex or triplex.

106. A method of detecting the presence, absence or amount of a particular single-stranded DNA or RNA in a biological sample, comprising the steps of:

contacting the sample with an oligomer of claim 3 under conditions wherein a hybrid duplex is formed between the oligomer and the DNA or RNA; and

detecting the presence, absence or amount of said duplex.

107. A method of inhibiting expression of at least one selected protein in a cell wherein the protein is encoded by DNA sequences and the protein is translated from RNA sequences, comprising the steps of:

introducing an oligomer of claim 3 into the cell; and

permitting the oligomer to form a triplex with the DNA or RNA or a duplex with the DNA or RNA whereby expression of the protein is inhibited.

108. The method of claim 107 wherein the oligomer is introduced into the cell by a method selected from the group consisting of calcium phosphate transfection, DMSO transfection, dextran transfection, electroporation, cationic lipid transfection, anionic lipid transfection or liposome transfection.

109. A method of introducing an oligomer of claim 1 into cells, comprising:

mixing the oligomer with a permeation enhancing agent to form a complex; and

contacting the complex with the cells.

110. A method of introducing an oligomer of claim 3 into cells, comprising:

mixing the oligomer with a permeation enhancing agent to form a complex; and

contacting the complex with the cells.

111. A method of synthesizing a desired oligomer of claim 1, comprising the steps of:

synthesizing a protected nucleomonomer synthon having a protecting group and a base and further having a coupling group capable of coupling to a nucleomonomer or oligomer;

coupling the nucleomonomer synthon to an acceptor nucleomonomer or an acceptor oligomer;

removing the protecting group; and

repeating the cycle as needed until the desired oligomer is synthesized.

112. A method of synthesizing a desired oligomer of claim 1, comprising the steps of:

synthesizing a protected oligomer synthon having a protecting group and a base and further having a coupling phosphite or phosphate group capable of coupling to a nucleomonomer or oligomer;

coupling the oligomer synthon to an acceptor nucleomonomer or an acceptor oligomer;

removing the protecting group; and

repeating the cycle as needed until the desired oligomer is synthesized.

113. The method of claim 111 wherein the coupling step is accomplished using hydrogen phosphonate, amidite or triester chemistry.

114. The method of claim 111 wherein the coupling phosphite or phosphate group is selected from the group consisting of hydrogen phosphonate, N,N-diisopropylamino-methylphosphonamidite, N,N-diethylmethylamino-phosphonamidite, N,N-diisopropylamino-β-cyanoethoxyphosphine, N,N-diisopropylamino-methoxyphosphine, N,N-diethylamino-β-cyanoethoxyphosphine, N,N-morpholino-β-cyanoethoxyphosphine, N,N-morpholino-methoxyphosphine, 2-chlorophenyl phosphate, 4-chlorophenyl phosphate, 2,4-dichlorophenyl phosphate, 2-chlorophenyl thiophosphate, 4-chlorophenyl thiophosphate, 2,4-dichlorophenyl-thiophosphate, and 2,4-dibromophenyl phosphate.

115. A method to synthesize a derivatized oligomer of claim 1 which comprises:

reacting an oligomer containing at least one 5-iodouracil, 5-iodocytosine or N^4-protected-5-iodocytosine heterocycle with R^2H in the presence of a Pd catalyst so as to convert said 5-iodouracil, 5-iodocytosine or N^4-protected-5-iodocytosine to the corresponding 5-R^2 substituted heterocycle.

116. A method of synthesizing a derivatized oligomer of claim 1, comprising the steps of:

synthesizing a protected precursor nucleomonomer synthon having a protecting group and 5-iodouracil or N^4-protected-5-iodocytosine as a base;

coupling the protected precursor nucleomonomer synthon to an acceptor nucleomonomer or an acceptor oligomer;

removing the protecting group;

repeating the cycle as needed until the oligomer is synthesized; and

derivatizing the precursor nucleomonomer synthon in said oligomer to a derivative having R^2 at the 5-position, where R^2 has the meaning defined in claim 1.

117. A method to evaluate a candidate antisense oligomer for its ability to inhibit gene expression, which method comprises

microinjecting said candidate antisense oligomer into a recombinant host cell along with (a) a target vector for the expression of a gene containing a target sequence for said candidate antisense oligomer, and (b) with a control vector for the expression of a control gene encoding a detectable protein, wherein said control gene does not contain said target sequence.

118. The method of claim 117 wherein said target vector is injected at about 2-4 copies per cell and said control vector is injected at about 30-50 copies per cell.

119. The method of claim 117 wherein said detectable protein is chloramphenicol acetyl transferase, luciferase or ß-galactosidase.

120. The method of claim 117 wherein said host cell is a mammalian cell.

121. A host cell which has been microinjected with (a) a target vector containing an expression system for a gene containing a target sequence for an antisense

ligomer, (b) a control vector containing an expression system for a detectable protein, and (c) a candidate antisense oligomer.

122. A method of amplifying nucleic acid comprising the steps:

mixing the oligomer of claim 1 with a sample containing target nucleic acid;

hybridizing the oligomer with the target nucleic acid; and

amplifying the target nucleic acid by PCR or LCR.

123. A method of amplifying nucleic acid comprising the steps:

mixing the oligomer of claim 3 with a sample containing target nucleic acid;

hybridizing the oligomer with the target nucleic acid; and

amplifying the target nucleic acid by PCR or LCR.

124. The oligomer of claim 1 wherein the oligomer is an antisense oligomer.

125. The oligomer of claim 3 wherein the oligomer is an antisense oligomer.

126. The oligomer of claim 1 wherein the oligomer is a triple helix oligomer.

127. The oligomer of claim 3 wherein the oligomer is a triple helix oligomer.